B.Sc. (Hons.) Part-II

Paper - IV

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2.1. INTRODUCTION

Soon after fertilization, the fertilized egg resorts to successive cell divisions. The division of cells is spoken of as cleavage. In this process there are usual mitotic divisions. But there is a subtle difference between the mitotic divisions in the adult and during cleavage. In the adult, after each mitotic division, the daughter cells regain the original size but in case of cleavage the resulting blastomeres do not increase in size, but are half the size of the orginal cell. The blastomeres have larger nuclei than those present in the somatic cells. This is due to large nuclear sap rather than chromatin mass. In other words, there is a progressive increase in the nucleocytoplasmic ratio during cleavage.

Every time there is a cleavage the DNA duplicates in s-period of the interphase. Ribosomal RNA is not synthesized during cleavage. Messenger RNA and transfer RNA are synthesized particularly during the later stages of cleavage. A number of proteins are synthesized during cleavage and these are histones, tubulin, ribonucleotide reductase, DNA polymerase, etc.

2.2. TYPES OF CLEAVAGE

(i) **Radial**—In this case, the blastomeres of the upper tier lie over the blastomeres of the lower tier, so that the pattern of blastomeres is radially symmetrical.

Ex. eggs of echinoderms.

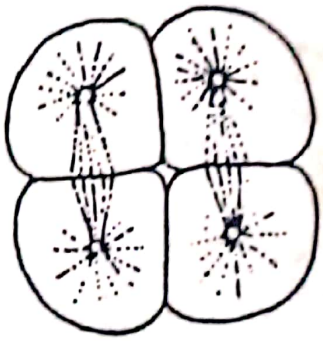

Fig. 2.1. Radial cleavage with equal-sized blastomeres (Viewed from animal pole, 4-cell stage)

(ii) **Spiral**—In protostomes, the blastomeres of the upper tier shift in the same direction in relation to the blastomeres of the lower tier. The oblique positions of mitotic spindles do not allow the two daughter cells to lie one above the other. Ex. annelids, molluscs, etc.

Depending upon the turn of the spiral, it may be called **dextral** (clockwise), and **sinistral** (anticolckwise).

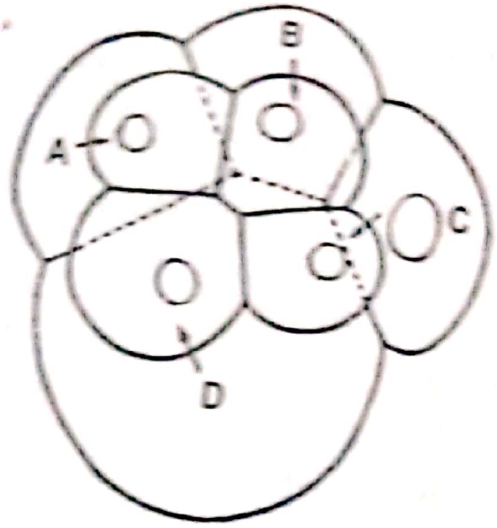

Fig. 2.2. Spiral cleavage in *Unio*. Blastomere D is larger than A, B, C.

(iii) **Bilateral**—In radial type of cleavage, out of the four blastomeres, two may be larger than the other two. This establishes the plane of bilateral symmetry. Ex. tunicates.

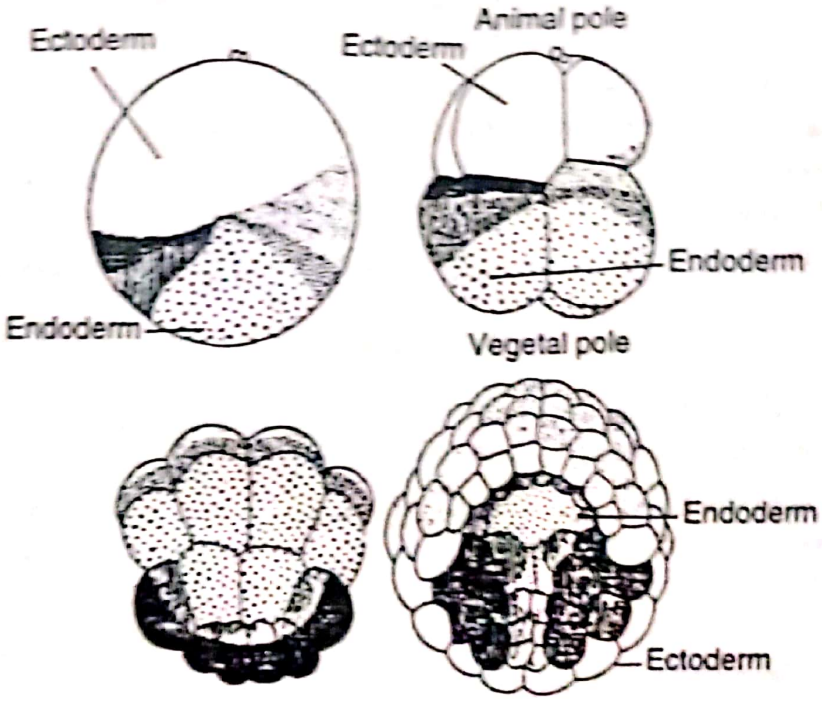

Fig. 2.3. Bilateral cleavages in Ascidian

(iv) Mosaic or determinate—In this type of cleavage, bilateral symmetry is established when the first division produces two unequal cells. The resulting cells then divide at right angles to each other giving rise to *T*-shaped blastomeres. In nematodes each of the blastomeres gives rise to specific parts of the embryo. This is the reason why such a cleavage is known as determinate type. Ex. nematodes.

The cleavage is greatly influenced by the distribution and amount of yolk in the fertilized egg. During the anaphase of the mitotic division, a furrow appears on the surface of the fertilized egg, known as **cytokinesis**. The furrow appears first in the area of the egg where there is little or less yolk. Gradually, there is a deepening of the furrow. But this is slowed down as it reaches the area where the amount of yolk is greater. Further accumulation of yolk in the vegetal hemisphere almost completely blocks the cell fission. In some cases, the cleavage furrow never reaches the vegetal pole so that the vegetal hemisphere remains uncleaved. This is known as **incomplete cleavage**. Ex. reptiles and birds. This type of cleavage is also called **meroblastic cleavage**. The other type of cleavage in which the hindrance is caused by the presence of yolk is not great enough to thwart complete separation of the two cells. In other words, when the two blastomeres become completely divided, the cleavage is called **holoblastic** or **complete**. Ex. *Amphioxus*, Frog.

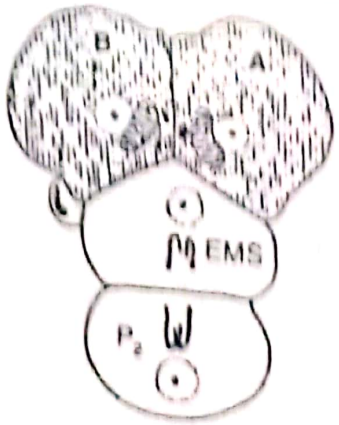

Fig. 2.4. Determinate cleavages in *Ascaris*

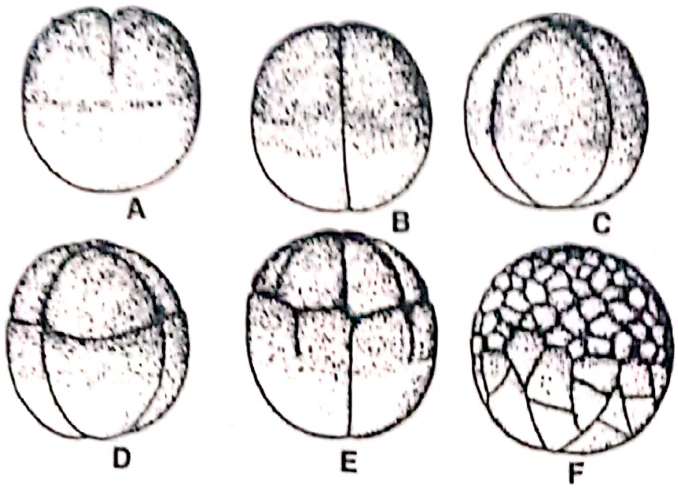

Fig. 2.5. Holoblastic cleavages in Frog egg (Semidiagrammatic)

In **centrolecithal eggs**, the cleavage is incomplete and the nuclei occupy the central position. Subsequently, these nuclei move to the periphery of the embryo. The nuclei are then surrounded by a small portion of the cytoplasm. The surface of the enbryo is syncytium with nuclei embedded in cytoplasm. Later on these cells become completely separated from the central yolk. This type of cleavage is known as **superficial cleavage**. Ex. insects.